NASA TECHNICAL MEMORANDUM

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NASA WORK UNIT SYSTEM USERS MANUAL

NASA Headquarters
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16. Abstract

The NASA Work Unit System is a management information system for research tasks (i.e., work units) performed under NASA grants and contracts. It supplies profiles to indicate how much effort is being expended to what types of research, where the effort is being expended, and how funds are being distributed. The user obtains information by entering requests on the keyboard of a time-sharing terminal. Responses are received as video displays or typed messages at the terminal, or as lists printed in the computer room for subsequent delivery by messenger.

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PREFACE

The NASA Work Unit System resulted from a need for a management information and control system to facilitate planning, direction, and review of the supporting research programs monitored by the former NASA Office of Space Science and Applications (OSSA). By 1967-68 it had become evident that the attendant requirements for access to a large and ever-changing bank of data no longer could be met in a cost-effective manner by existing manual techniques.

The concept of a mechanized system was originated by Mr. Franklin G. Tate of the OSSA Program Support Branch. Working at first independently and then with the assistance of a contractor firm, Mr. Tate carried the idea through initial design, feasibility analysis, and implementation of a prototype system employing electronic accounting machine (EAM) equipment. After the feasibility had been demonstrated in 1969-70, work on the present system was started in the fall of 1970.

The current version, which was developed through the NASA Management Systems Office during 1971 and early 1972, utilizes interactive computer terminals in conjunction with time-sharing services as a means of more economically and effectively responding to the data processing requirements of the system.

Although further refinements are planned, the Work Unit System is an ongoing system that permits user offices to query or update files through remote terminals. Now serving both the Office of Space Science (OSS) and the Office of Applications (OA), the system provides needed support in the administration and review of research programs over which these two offices have cognizance. Its capabilities can be employed in connection with planning research programs, evaluating proposals, scheduling interviews, ensuring timely renewals or terminations, and accomplishing other activities related to program support.

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SECTION 1
INTRODUCTION

The NASA work Unit System is a basic management information system for research tasks (i.e., work units) performed under NASA grants and contracts. Although it deals with information on specific projects, its purpose is to provide management with broad overviews of research efforts in the aggregate. To this end, the system supplies profiles indicating the amount of effort devoted to various types of research, where the effort is being expended, and how funds are being distributed.

The system will permit a user to obtain information by entering requests on the keyboard of a time-shared terminal. Data can be received in any of three forms:

- Displays shown on a video screen
- Messages typed automatically at the terminal
- Lists printed in the computer room and subsequently delivered by mail or messenger

The user does not need data processing knowledge or typing skill.

This manual explains how to use the system to obtain specific information and how to use the terminal to assemble information in any of 175 reports or lists. Section 2 contains a summary of information about the system. Remaining sections of the manual provide details for study and reference.

SECTION 2
ABOUT THE WORK UNIT SYSTEM

2.1 Purpose

Any organization that sponsors research work under grants or contracts has responsibilities extending beyond the scope of monitoring technical performance. Some of these responsibilities are related to overall review and planning to ensure optimum allocation of funds and proper distribution of effort. Others, particularly if the organization deals with public funds, are concerned with responsiveness to extramural interests.

The NASA Work Unit System is intended to supply the kind of information needed to fulfill such responsibilities. It contains administrative and funding information pertinent to research tasks and provides the user with means of examining the information sorted and grouped in a variety of ways. In addition to supporting simple requests, e.g., questions concerning the amount of money being spent in a certain State or at a certain institution, the system furnishes detailed lists capable of aiding in the formulation of plans for redirection of research effort.

2.2 Nature of the Information

The system was designed around the research tasks monitored by the Office of Space Science (OSS) and the Office of Applications (OA). Each research task, or work unit, is represented by a computer record containing 29 data fields. Although these fields are discussed in detail in Section 3 of this manual, a list is provided in Table 1 to indicate the kind of information handled by the system.

Funding information (items 12 through 18 in Table 1) is supplied from files under the cognizance of the Headquarters Accounting Branch and the Agency Accounts and Reports Branch of the NASA Financial Management Division. Because this information is already in machine-readable form, it is not necessary for the file maintenance operator to key it again.

Table 1. NASA Work Unit System Record Fields

Record Field	Content (Field Value)
1. TASK#	Task number
2. PRINV	Principal investigator
3. MONIT	NASA monitor
4. INAME	Institution name (i.e., performing institution)
5. CONT#	Contract number
6. ICITY	Institution city
7. ISTAT	Institution state
8. SDATE	Starting date
9. ADATE	Anniversary date
10. CDATE	Commitment date
11. ODATE	Obligation date
12. CY-3$	Obligated funds for the fiscal year 3 years ago
13. CY-2$	Obligated funds for the fiscal year 2 years ago
14. CY-1$	Obligated funds for the last fiscal year
15. CPLN$	Planned funds for the current fiscal year
16. CCOM$	Committed funds for the current fiscal year
17. COBL$	Obligated funds for the current fiscal year
18. BDYR$	Planned funds for the budget year (i.e., next fiscal year).
19. INCAT	Institution category (university, industrial, etc.)
20. STATU	Status code for the task (for the 5 years of Fields 12-18)
21. ICODE	Institution code (identifying code for the institution)
22. SIGAU	Signature authority
23. SUPRQ	Support required (balloon, aircraft, etc.)
24. ACTI%	Activity percentages (theory, data reduction, etc.)
25. WRKSP	Work support (automated, manned, etc.)
26. SCDIS	Scientific discipline
27. TITLE	Task title
28. DBSCD	Data base code
29. PSDCD	Division pseudocode

At regular intervals the current information is transferred programmatically from the financial files to Work Unit System files. Funding information for research tasks under the control of NASA Headquarters is extracted from files of the Financial Accounting System Teleprocessing (FAST).[1]

Funding information for research programs under the control of installations is extracted from files of the Financial Status of Programs System (FSOP). At present, FAST figures are broken down to the detail level of individual tasks, but field installation figures are available only at the RTOP level. (Subsection 3.1 presents a discussion of RTOP's.)

[1] Formerly Headquarters Financial Accounting System (HFAS)

The five-character codes shown in Table 1 for these fields are mnemonic designations used in dialogues with the system. The file maintenance operator uses all of them, but the ordinary terminal user only needs the first five.

2.3 Using the System

The user will be working at a terminal located in his own office area. The terminal can be any of several types, possibly a typing terminal or possibly one that displays messages on a video screen. It will have a standard typewriter keyboard with some additional keys for special instructions. The user will type brief instructions on the keyboard and will receive messages either displayed on a video screen, or typed by the terminal device, or both. A typical terminal keyboard is illustrated in Figure 1.

2.4 Displaying a Single Record

The first five fields listed in Table 1 are search fields for spot answers. By keying in one of the five mnemonic codes, the user can call up a display of a single record.

After the user has executed a brief sign-on routine in this process, the system will ask what function it is to perform; the user will answer by typing the letter Q (for QUERY). If, for example, the user wants to know the name of the principal investigator, the nature of the scientific discipline, or some other fact about Task No. 160-44-51-09-51, the following dialogue will take place:

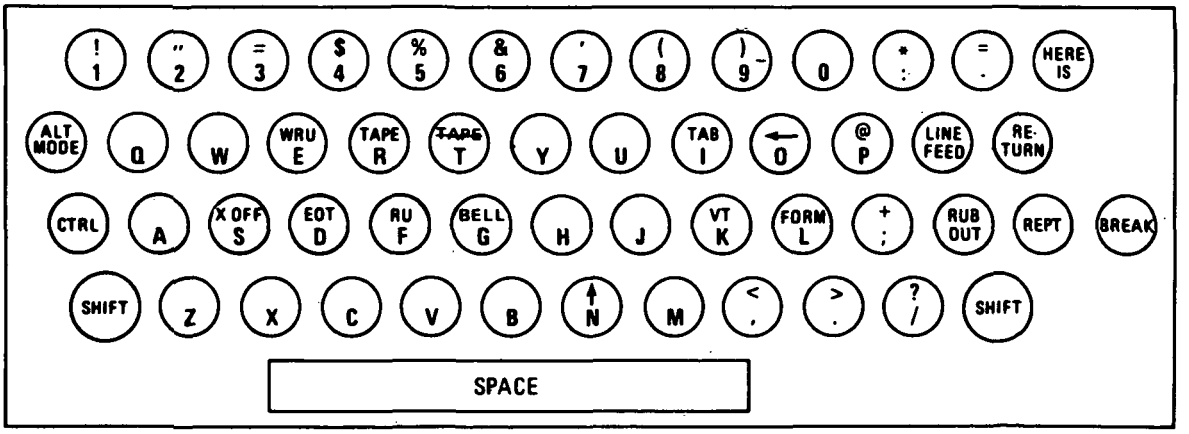

Figure 1. Typical Terminal Keyboard

User: Q (User strikes carriage return after every entry.)

System: ENTER NAME OF SEARCH FIELD

User: TASK#

System: ENTER SEARCH FIELD VALUE

User: 16044510951

System: WOULD YOU LIKE DISPLAY OF RECORD?
INPUT Y OR N

User: Y

System: WANT HEADING?

User: Y

The system will then provide two formatted displays. One will name the fields; the other will furnish the value of each field (i.e., the information that has been entered into each field).

The heading is always the same, and the positions of the field values in the display will always correspond to the positions of the field names in the heading. The user will soon become familiar with the format and, at times, will elect not to display the heading. Figure 2 illustrates the standard heading format. This is the display the user will see if he has called up the record for Task 160-44-51-09-51. (Some of the 29 fields are omitted from query displays.)

This same function can be exercised for any of the first five fields named in Table 1. Therefore, in addition to querying on a task number, the user can query on a principal investigator's name, a NASA monitor's name, an institution name, or a contract number. It is important for the reader to remember that this particular use of the terminal is intended primarily for summoning single records. Because there will only be one record for each task number, this is the record that the user will see when he uses this field. The same will usually be true of a contract (or grant) number, although there may be two or more grants for an occasional task.

```
TASK NUMBER          INSTITUTION NAME
INSTITUTION CITY       INST STATE  CONTRACT NUMBER    STRT DATE  ANV DATE
PRIN. INVESTIGATOR   NASA MONITOR          PRIOR YR OBLIGATIONS
CURRENT YEAR                        BD YR AMT  IN CAT  STATUS  IN CODE
SIG AUTH  SUP REQ    ACTIVITY %       WRK SUP  SCI DIS
TASK TITLE
                                                          DBSCD PSDCD
-------------------------------------------------------------------------

160-44-51-09-51      COLORADO STATE UNIVERSITY
FORT COLLINS           COLO         NGR 06-002-098       -         01-71
E   REITER            V   SALOMONSON                  -        -
     60-       -  -  -       -  -          60    UV       ***NC     C41990
          *-*-*-*-X  50-  -50-  -     A          SRM
INTER HEMISPHERIC DIFFERENCES IN THE ATMOSPHERIC CIRCULATION FROMSATEL
LITE DATA                                                        1  3
```

Figure 2. Record Display in Response to Query

It must be recognized, however, that a principal investigator may be involved in several tasks, a NASA monitor may have cognizance over quite a few, and an institution may have any number of contracts or grants for research tasks. Thus, it may be more convenient to use one of the system's printed output reports or lists to obtain information concerning principal investigators, monitors, or institutions. There will be times, though, when the user will find it more expedient to summon information of this type at the terminal.

The procedure for doing so is an iterative one. The user repeats his request as often as necessary, receiving a new record each time until the system has delivered all of them. Suppose, for instance, the user needs to see the records for all the tasks in which J. Q. Smith is involved as a principal investigator. He initiates a request according to the procedure outlined above, entering PRINV instead of TASK# and supplying the message JQSMITH in answer to the field value question. After the record has been displayed he repeats the process. If J. Q. Smith is involved in only one task, the second record will be identical to the first. If he is involved in more than one task, the second record will be different, and the user will continue to summon records on J. Q. Smith until the system again displays the initial record.

2.5 Selecting Printer Output

In addition to supporting queries for individual records, the system permits the user to enter instructions at the terminal for various printouts to be batch processed and produced on the line printer in the computer room. These printout products, which are delivered by messenger, are intended for lookup use. There are 25 different types, each of which provides some special arrangement of data elements for a particular purpose. One product lists all tasks currently ongoing in each State, another lists all tasks in each division of OSS or OA categorized by the installations having cognizance over them, and so on. Most products give subtotals and totals for funding as well as numbers of tasks.

To initiate a run for one of these products, the user selects the file and the computer program to be used. The two files available at present are the OSS file and the OA file. There are 25 programs, one for each of the 25 types of output. Of these, 16 are report generators designated as output selection (OS) programs, and nine are list producers known as list output selection (LOS) programs. It has become the practice to use the program designation to identify each program's product. Thus Program OS-5 generates what is known as an OS-5 Report.

While the user will soon become familiar with the characteristics of the various reports, it is not necessary for him to memorize them. These reports, which are listed in Tables 3 and 4 (page 41 and 44 respectively) and included in the index, are discussed in detail in Section 4.

In addition to choosing the file and program, the user has the option of limiting his output to certain subfiles. Treated as subfiles by the system, these are actually separate data bases of interest to different groups of users. At present, there are seven of them:

1. Supporting research and technology (SR&T)
2. Data analysis
3. Advanced studies

4. Institutional

5. Sounding rockets

6. Manned spaceflight experiment development

7. Other

The system is designed so that each file/program combination will produce seven output products, one for each of the above data bases. If the user calls for an OS-5 report from the OSS file, for example, he can expect to receive seven separate reports. However, if he wants to restrict his output to only one, or to only certain ones, he can do so.

In effect, then, with seven for each of the 25 selections, the system will produce 175 different products from each file. A combined set for OSS and OA will consist of 350 different products. The development of production schedules for the various products is primarily a matter of administrative need. Some may be required monthly, some irregularly, and some only once or twice a year. Any product can be generated on demand to meet special requirements.

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SECTION 3
CONTENTS OF THE RECORD

3.1 Task Number (TASK#)

The NASA research task number is an 11-digit code in the form ABC-DE-FG-HI-JK. The segments not only identify a specific task, but indicate its subject area and the NASA installation having cognizance over it. The subject matter is represented by the seven-digit segment ABC-DE-FG, known as the RTOP number. An RTOP is a Research and Technology Operating Plan, delineated on a NASA Form 1471, that represents an effort directed toward a particular goal. The digits in the HI position represent the sequential number for an individual task under a particular RTOP, and those in the JK position identify the cognizant installation. As an example, Task 160-44-51-09-51 thus can be interpreted as follows:

Segment	Meaning
160-44-51	RTOP number (optimum remote sensing techniques for meteorology)
09	Task number 09 for RTOP 160-44-51
51	Goddard Space Flight Center

The numbering system for the RTOP's conforms to the NASA Agency-Wide Coding Structure, for which NASA Financial Management Manual 9100 is a prime information source. Figure 3, a representation of the manual page that contains 160-44-51, illustrates the classification scheme. Table 2, extracted from another page in the same manual, lists the code numbers for the various installations.

3.2 Principal Investigator (PRINV)

The principal investigator's name is entered with initials first, surname last, no punctuation, and no spaces. Thus J. Q. Smith will appear as JQSMITH. With one initial, the form is J SMITH (with a space).

Coding for R&D and R&PM Appropriations			FMM 9130-101
Office of Application			
Code (Digits)			
Unique Project	System or SRT	Subsidiary Breaks	
123	45	67	Nomenclature
160	00	00	Earth Observations SR&T
	20	00	Technology
		51	S/C Systems and Technology
		52	Data Management and Storage
		53	Visible and IR Sensor Technology
		54	MW & MM Wave Radiometer Sys Dev
		55	Cooling Systems
		56	Air Pollution Sensing
		57	Chem & Spectro Stdy-Air Pollution
		58	Adv. Sensor Feasibility
		59	High Speed Interferometer Exp Dev
	44	00	Meteorology
		51	Optim Remot Sens Techs for Met
		52	Appl Met Sat Data to Gen Circ Met
		53	Rem Sens Tech-Cld Struc/Prec/Su
		54	Rad Trans Mod/Atmos & Surf Char
		55	Anal Energ Interact Bet Atmos L
		56	Lab & Fld Exp & Calif & Radia S
		57	Airborne Meteorology Program
		58	Climatol Mod of Atmos & Cloud C
		59	Atmos Transmit for 4.3 & 15 Mic
		60	Atmos Effects Upon Remote Sens
		62	Util Apollo Phot for Mesoscale
	75	00	Earth Resources
		50	Earth Res Sens Instrumentation
		51	Earth Res Multichan Surf Sens
		52	Data Mgmt Info Extr & Proc Inst
		53	Manip, Valid & Record Image Data
		54	Earth Res Studies with Nimbus
		56	Hardware for A/C & S/C Acquired
		57	Earth Resources Sensing Instrum
		58	U/Michigan Special Competence Gro
		59	U/Kansas Special Competence Gro
		60	Midwest/Great Lakes Appl of Eo
		61	Earth Res Data Anal Instrtn &
		65	Agr & For Remot Sens Res & Tech
		66	Spacecraft Oceanography Project
		67	Oceanography Studies (ESSA)
		68	Hydrology Studies (ESSA)
		69	Geologic Remote Sensing Program
		70	Hydrology, USDI
		71	Urb & Region Chng Det & Pred (G)

Figure 3. RTOP Numbers from Agency-Wide Coding Structure

Table 2. NASA Installation Codes

Code	Installation
10	NASA Headquarters
15	Mission Analysis Division (for reporting purposes only)
21	Ames Research Center
22	Lewis Research Center
23	Langley Research Center
24	Flight Research Center
42	Space Nuclear Propulsion Office/Cleveland
44	Space Nuclear Propulsion Office/Nevada
45	Space Nuclear Propulsion Office/Washington, D.C.
51	Goddard Space Flight Center
53	Wallops Station
55	Jet Propulsion Laboratory (for reporting purposes only)
56	NASA Pasadena Office (for reporting purposes only)
62	Marshall Spaceflight Center
72	Manned Spacecraft Center
76	John F. Kennedy Space Center

3.3 NASA Monitor (MONIT)

The name of the individual with monitoring responsibility is entered in a form identical to that used for the principal investigator's name.

3.4 Institution Name (INAME)

The institution, as treated in the Work Unit System, is the organization responsible for the execution of the task. It can be a NASA installation, a contractor organization, or a grantee organization.

Standardization of institution names is provided editorially through a master list. A copy of this list at the terminal will permit the user to determine the exact character-by-character form in which a name has been entered on the file. When querying on an institution name the user must key the name exactly as it appears on the file. The program simply matches names. Thus, if the user deviates even by so little as a space or a punctuation mark, the system will be unable to match his keyed message and will report that the requested item is not on the file.

3.5 Contract Number (CONT#)

For all practical purposes, the contract number and the grant number are equivalent in this field. The number of the contract instrument, whether it is a contract or a grant, appears in this field.

3.6 Institution City (ICITY)

The name of the city where the performing institution's principal office is located is contained in this field. It usually corresponds to the one referred to in some NASA systems as the place-of-performance (POP) city.

3.7 Institution State (ISTATE)

This field contains the State in which the above city is located. Since there are only five character positions in the field, the State name is usually abbreviated.

3.8 Starting Date (SDATE)

The task starting date (month and year) is entered in the form MMYY. (For example, January 1973 is entered as 0173).

3.9 Anniversary Date (ADATE)

The anniversary date, which is entered as MMYY, is the expiration date of the grant or the equivalent thereof. In general, it is the date when appropriate action will be required to review or extend a task.

3.10 Commitment Date (CDATE)

The date when procurement funds were committed is entered as MMYY.

3.11 Obligation Date (ODATE)

The obligation date (equivalent to the date of award of the most recent contract or grant) is entered as MMYY.

3.12 Obligated Funds Three Years Ago (CY-3$)

The total funding obligated for this task for the fiscal year 3 years ago is entered in thousands of dollars.

3.13 Obligated Funds Two Years Ago (CY-2$)

This field contains obligated funding as described for Field 12 (CY-3$), but for the fiscal year 2 years ago.

3.14 Obligated Funds One Year Ago (CY-1$)

This field contains obligated funding as described for Field 12 (CY-3$), but for the immediate past fiscal year.

3.15 Funds Planned for the Current Fiscal Year (CPLN$)

Funding planned is defined as estimated funding for which procurement has not yet been initiated. Figures are entered in thousands of dollars.

3.16 Funds Committed for the Current Fiscal Year (CCOM$)

Funding approved, but not yet represented by a grant or negotiated contract, is entered in thousands of dollars.

3.17 Funds Obligated for the Current Fiscal Year (COBL$)

The dollar value of the grant or contract is rounded to the nearest number of thousands if necessary.

3.18 Funds Planned for Budget Year (BDYR$)

Planned funding, as defined above, is entered in thousands of dollars. The budget year is defined as the fiscal year immediately following the current one.

3.19 Institution Category (INCAT)

The information in this field is coded according to the following:

- UV = University
- UM = University medical school
- NP = Nonprofit
- IN = Industrial
- FC = Field center
- OT = Other

3.20 Status Code (STATU)

There are three status codes:

- C = Continuing research
- N = New research
- F = Completed research

This field has five character positions, one for each of the past 3 fiscal years, one for the current fiscal year, and one for the upcoming fiscal year. One of the above three letters is entered in each of the five positions. An example might be: NCCCF. If the task did not exist in any particular year, that position is left blank. A blank field is represented by an asterisk in a terminal display.

3.21 Institution Code (ICODE)

The master list giving the authorized forms for institution names also gives an alphanumeric code for each one. This code contains six characters. For example, the code for the University of Nevada is U83100. The reason for the two fields is one of access expediency. It is considered easier for the user to search on the actual name in Field 4 when entering a query; but it is easier for the computer to manipulate the code when extracting and sorting data for reports or lists.

3.22 Signature Authority (SIGAU)

This field is intended to accommodate a figure representing the dollar level of authority delegated to the division director by the associate administrator.

3.23 Support Required (SUPRQ)

The following five codes are used for support:

- B = Balloons
- A = Aircraft
- R = Rockets
- O = Other
- N = None

Because more than one type of support may be required for a task, this field will accommodate multiple entries. For display purposes the terminal provides a formatted B-A-R-O-N message, in which an X represents an entry and an asterisk represents a blank. For example:

* - * - X - * - *

The presence of the X in the third (i.e., R) position indicates that rockets are required to support this task. The purpose of this field is to provide an alerting tool. The Work Unit System flags the need for such items as balloons or rockets to enable the user to investigate and take appropriate action to provide them.

3.24 Activity Percentages (ACTI%)

This field provides 10 character positions, two for each of the following:

- Theory
- Instrumentation development
- Data reduction
- Ground research
- Program support

For example, if a task is 20 percent theory, 50 percent instrumentation development, and 30 percent data reduction, the terminal will display the following message:

20-50-30-

3.25 Work Support (WRKSP)

This field will contain one character representing a subjective decision by the NASA monitor as to what part of the NASA program this task supports. The possible characters are:

- A = Automated (i.e., unmanned)
- M = Manned
- B = Both

3.26 Scientific Discipline (SCDIS)

A three-letter code is entered in this field to signify the scientific discipline that encompasses the task. The codes and the disciplines they represent are listed below:

CODE	Discipline
MAL	Lunar physics--geodesy and cartography
ECC	Communications satellite technology
ECE	Advanced systems--communications
ECF	Advanced programs and technical communications
ECM	Data collection
ECN	Navigation and traffic control
ECP	Interdisciplinary applications
ECS	Applications technology
ERF	Earth observation technology
ERG	Earth physics
ERM	Meteorology
ERP	Interdisciplinary--earth resources
ERR	Earth resources
SGA	Astronomy
SGE	Interdisciplinary--space science
SGI	Magnetospheric physics
SGM	Interplanetary dust and cometary physics
SGP	High-energy astrophysics
SGS	Solar physics
SGT	Advanced technological development
SLA	Planetary atmospheres

Code	Discipline
SLB	Planetary biology
SLD	Advanced technical development
SLP	Interdisciplinary--planetary
SLQ	Planetary quarentine
SLR	Planetology
SLT	Planetary astronomy
SVA	Advanced studies--launch vehicles
SVG	Guidance--launch vehicles
SVI	Instrumentation--launch vehicles
SVP	Propulsion--launch vehicles
SVS	Structures and materials--launch vehicles
SVV	Launch vehicles studies

3.27 Task Title (TITLE)

The record provides up to 130 character spaces (characters or blanks) for the title. The field actually contains three line segments of 50, 50, and 30 characters respectively.

3.28 Data Base Code (DBSCD)

Each of the system's files (the OSS file and the OA file) really represents seven subfiles, one for each of the following:

- 1 = Supporting research and technology (SR&T)
- 2 = Data analysis
- 3 = Advanced studies
- 4 = Institutional
- 5 = Sounding rockets
- 6 = Manned spaceflight experiment development
- 7 = Other

Although the system's records could be broken down into seven separate files for OSS and seven for OA, it is more convenient to group them together and provide a one-character position identifying the subfile (or data base).

The user will discover that each report or list produced by the system represents only the tasks for one of these seven data bases. On a report or list, the data base is identified in the top lefthand corner by the name of the data base from which it was extracted.

The query program, on the other hand, addresses an entire file (OSS or OA). In the display provided for a query, the data base is identified in the lower righthand corner by the number. For example, a 3 in this position indicates that the task represents an advanced study.

3.29 Division Pseudocode (PSDCD)

Currently there are six divisions represented in this field. Two of them are now represented only in the OA file; the rest are represented only in the OSS file. In the original integrated OSSA file the six divisions were assigned simple numeric codes. When the OSSA file was divided, the original codes were retained for purposes of system efficiency. Following are the numeric codes along with the names and file assignments of the divisions:

- 1 = Apollo exploration (OSS)
- 2 = Communications (OA)
- 3 = Earth observations (OA)
- 4 = Launch vehicles (OSS)
- 5 = Physics and astronomy (OSS)
- 6 = Planetary (OSS)

As in the case of the data base code, the name of the division appears in a report or list, and the code number appears in a terminal display.

SECTION 4
USING THE SYSTEM

4.1 Terminal Equipment

Since the NASA Work Unit System can be accessed through a variety of commercial terminal devices, it is impossible to predict just which ones the user will encounter at his location. Although some terminal equipment looks rather complex, it is usually easy to operate. It can be assumed that proper instructions on its use will be provided by the manufacturer's representative or by someone in the user's own organization. However, such devices have enough similarity to permit a general discussion here of what the user can expect to find.

A typical terminal installation consists of a telephone, a data transmission unit, and a video device. It also may have an automatic typewriter or other typing unit connected to it. The data transmission unit is a small box with two openings in the top designed to receive the speaker and receiver of the telephone handset. The video device resembles a television set with a keyboard. The printing device may resemble a typewriter, or it may be merely a small box-like unit.

Terminals are set for different rates of transmission and receiving. The unit for measuring the rate is the baud, representing a rate of one bit per second. Thus the statement that a terminal is set at 300 bauds means that it transmits and receives at a rate of 300 bits per second. Typically, a video terminal is set at 300 bauds, and a teletypewriter is set at 110 bauds. The user should know the rate of transmission of his local terminal. In all probability it will be either 110 or 300 bauds.

To activate his terminal, the user turns on all necessary switches, dials the phone number of the network, and sets the telephone handset in the two openings of the transmission unit. When a connection has been made and the terminal is ready for use, one or more signals will be received. Typical signals are a colored light on the data transmission unit

and a flashing spot somewhere on the video screen. After these signals have appeared, the terminal is ready for use. The user operates the terminal much as he would an ordinary typewriter, keying his messages on the keyboard and receiving answers either on the video screen, through automatic typing, or both. During each session at the terminal the user is required to execute a brief sign-on and identification routine before performing his functions and a sign-off routine before disconnecting and turning off the switches. After the user has learned how to operate the specific equipment at his location he will be ready to use it for the Work Unit System as described in the following sections.

4.2 Sign-On for Querying the System

The NASA Work Unit System provides service through a network operated by the General Electric Company. The files are located in Cleveland, Ohio, and input/output processing is accomplished through a General Electric service bureau in Bethesda, Maryland. To reach the system, the user can dial any of the following Bethesda numbers:

- 652-4445
- 656-1920
- 656-2720
- 656-2734

If the user receives a busy signal or if the phone rings six or seven times without response, he should try another number. A successful connection is indicated by a steady, high-pitched tone usually after two or three rings. Upon hearing the tone, the user should place the handset in the transmission unit and wait for the proper "connected" signals, as discussed in subsection 4.1.

As soon as the signals are received, the terminal is ready for sign-on. If the terminal is set at 300 bauds (reference subsection 4.1), the user should key in the letter H two or three times. If it is set at 110 bauds, he should do nothing. In either case, he will soon receive the following message:

Beginning with this message, the following dialogue will take place:

System: U#=

User: RES99999 (Same number for all users.)

System: Resource ID-

User: (The user enters the resource identification number, which will be furnished to him through administrative channels. The system then will display a string of characters resembling strikeovers. When this string has been generated by the system, the user enters the password, which also will be furnished to him through administrative channels. He will not be able to read the password because it will be printed over the line of "garbage" just generated by the system for security purposes.)

System: SYSTEM?

User: CARD

System: OLD OR NEW-

User: OLD OSSQ
(This will summon the OSS file for querying. If the user wishes to use the OA file, he enters the message OLD OAQ.)[2]

System: READY

User: RUN

System: FUNCTION (Q, A, D, OR E)?

User: Q

The system is now ready for the user to submit his queries. Before the submission of queries is discussed, however, the function question should be explained. The other three functions mentioned in the system

[2]The word OLD and the letter Q refer to computer programs, not to files, and are provided for the user in making queries. There is another combination employing the word NEW, but it can be used only by the programmer when making changes to the system. If the user enters a command containing the word NEW, the system will not function beyond this point.

message above are ADD, DELETE, and END. ADD and DELETE functions are to be performed by the file maintenance operator, who is responsible for adding records to or deleting them from the file. The ordinary querying user will exercise only QUERY and END functions. The reasons for this are discussed below.

4.3 File Security

File security is an extremely desirable feature in any teleprocessing system, especially in one dealing with management information. There are three basic requirements to consider. The first is preventing inquisitive people from wasting computer time or perhaps even doing damage by "playing" with the equipment; the second is making the information available only to authorized persons; and the third is protecting the records from inadvertent or deliberate alteration by individuals other than the operators responsible for file maintenance. The first two are handled through the "garbage" line that obliterates the password. If, for instance, an unauthorized person had access to a terminal printout of the dialogue discussed in subsection 4.2, above, he could execute the steps of the sign-on procedure down to the entry of the Resource ID. At that point he would receive the "garbage" line and have no way of knowing what to do next. Even if he understood enough about teleprocessing systems to know that this display masked a password, unless he actually knew the password he would not be able to proceed further.

The last of the three considerations, preventing unauthorized alteration of the records, is handled by a system feature known as write lockout. This feature permits the user to process queries without interruption, but prevents him from adding, deleting, or changing records.

The password procedure is an integral part of General Electric's GECOS III time-sharing system, which provides the service for the Work Unit System. The write lockout feature, however, is an option exercisable by the maintenance programmer or the file maintenance operator. The question of when to set the write lockout on the master file is thus purely administrative.

If circumstances call for the write lockout, the manager of a file has several options in its use. He can order the write lockout to remain set except during brief periods (perhaps outside normal working hours) when update transactions are being processed. However, he probably will find it more expedient to choose the opposite course of keeping the file open for changes except when lists and reports are being processed. There are several reasons for this. With numerous tasks involved, changes can occur almost daily throughout the year. It is desirable to keep the files as current as possible to enable prompt posting of these changes. For this purpose it will be desirable to have the file ready to accept changes whenever it is convenient to enter them. Conversely, when the time comes to generate a series of lists or statistical reports (monthly, quarterly, etc.) it will be desirable to maintain consistency in this series of outputs by avoiding changes to the file between the first and last in the series. The simplest way to guarantee this consistency is to set the write lockout before the first report and release it after the last one.

The write lockout can be set and released only by the file maintenance operator or the programmer. Unless a particular user also happens to have file maintenance responsibilities, he need not be concerned with write lockouts. While it is possible that the ordinary user will never encounter a write lockout, he should understand the process. The following discussion explains the effect of a lockout and actions to be taken under lockout conditions.

The existence of a write lockout is evidenced by a notice appearing immediately after the user's RUN instruction and before the system's FUNCTION question. At this point the system displays the following message:

```
WRITE LOCKOUT IS SET ON MASTER FILE.
ANY ATTEMPT TO ADD TO, DELETE FROM, OR CHANGE
EXISTING DATA ON FILE WILL RESULT IN A CONTROLLED
ABORT OF THE RUN WITH RETURN CODE = 9
YOU HAVE BEEN NOTIFIED
FUNCTION (Q, A, D, OR E)?
```

If he so chooses, the user can regard this as nothing more than a notice introduced just before the system presents the FUNCTION question. The simplest procedure is to answer the FUNCTION question with a Q and proceed with the query operations as they are described in subsection 4.4.

If the user should be tempted to experiment by entering A (for ADD) or D (for DELETE) when the write lockout has been set, the system will lead him through some steps of the function he has called for and then will display the abort message:

```
RUN ABORTED - CALL FOR PROGRAMMER ASSISTANCE
RETURN CODE = 9
ACTIVITY TERMINATED
```

Return code 9 is the system's code for an attempt to violate a write lockout. Other conditions, primarily malfunctions, are capable of aborting runs. All of them have their own return codes for use by the programmer in diagnosing and clearing up difficulties. Whenever the user encounters a RUN ABORTED message, regardless of the return code, the simplest thing for him to do is to key the word BYE. This will, in effect, sign him off. The system will provide brief closing messages on resources used and time of sign-off followed by SESSION ENDED. It then will present the message U#= and, after a few seconds, repeat the U#=.

When the U#= has appeared for the second time, the user can supply the RES99999 and proceed with a new sign-on routine, following the steps

given in subsection 4.2. He should be able to process a new query without interruption, especially following an abortion caused by lockout violation. However, if the new attempt results in another aborted run, he should sign off with BYE once more and consult the programmer before attempting to use the system again.

There is one other point in the query dialog at which the user will trigger an aborted run if he supplies the wrong answer. Immediately after the system has displayed a record in response to a query, it displays the following message:

```
DO YOU WANT TO CHANGE A FIELD VALUE?
INPUT Y OR N
```

This message appears because the file maintenance operator also uses the query routine to make necessary changes in the records. If the write lockout has not been set, the file maintenance operator can branch off into a different dialogue to make his changes by answering Y to this question. However, if the write lockout has been set, any attempt to make file changes will soon lead to the RUN ABORTED message discussed above.

4.4 Entering Queries

The query function, discussed briefly in Section 2, is a process through which the user can summon a display of one record. This function operates on any of five fields: task number; principal investigator; NASA monitor; institution name; and contract number. The type of display produced by a query was illustrated in Figure 2.

The question of when to display the heading and when to dispense with it is an option that the user may exercise at will. The format of the displayed record never changes, regardless of which field is used for the query.

Each of the five query fields has its own special characteristics. These are discussed separately below.

4.4.1 Task Number Query

The NASA task number is the one data element that definitely distinguishes one particular record from all others. If the user knows a task number and wishes to see the record for it, he can summon the display by using this number. The dialogue and display for a task-number query are illustrated in Figure 4.

Attention is called to the dialogue accompanying the display in Figure 4. This contains some steps that have not been mentioned so far in this manual.

The HEADING question, for example, has been mentioned as a user option, but discussion of the DISPLAY question has been deferred until this point to minimize interruptions in the presentation. Since the purpose of a user's query is to call up a display of a record, although he may not need to see a heading display every time, the user will always answer Y to the DISPLAY question. The question is included for the convenience of the file maintenance operator to enable him to save time when making minor changes. If the file maintenance operator answers N to the DISPLAY question, the system bypasses the HEADING question and skips to the question DO YOU WANT TO CHANGE A FIELD VALUE?

This question also is intended for use by the file maintenance operator. As indicated in subsection 4.3, if Y is entered when a write lockout has been set, an aborted run will result. If Y is entered in the absence of a write lockout, the system will branch into the record-change dialogue, and the user will lose his ability to continue querying. In either event, the only choice left to the user will be to terminate his session with a BYE command. Therefore, the querying user should always answer this question in the negative. The negative answer will produce the FUNCTION question once more. If the user wishes to enter another query, he can answer it with a Q. If not, he answers E.

```
U#=RES99999


RESOURCE ID
[redacted]

SYSTEM ?CARD

old or new-OLD OAQ

ready
RUN

FUNCTION (Q, A, D, OR E)?
?Q

ENTER NAME OF SEARCH FIELD
?TASK#

ENTER SEARCH FIELD VALUE
?160445109 51

WOULD YOU LIKE DISPLAY OF RECORD?
INPUT Y OR N
?Y

WANT HEADING?
?Y

-------------------------------------------------------------------------
TASK NUMBER          INSTITUTION NAME
INSTITUTION CITY       INST STATE  CONTRACT NUMBER   STRT DATE  ANV DATE
PRIN. INVESTIGATOR   NASA MONITOR          PRIOR YR OBLIGATIONS
CURRENT YEAR                          BD YR AMT  IN CAT  STATUS  IN CODE
SIG AUTH  SUP REQ    ACTIVITY %        WRK SUP  SCI DIS
TASK TITLE
                                                          DBSCD PSDCD
-------------------------------------------------------------------------

160-44-51-09-51      COLORADO STATE UNIVERSITY
FORT COLLINS           COLO        NGR 06-002-098       -        01-71
E   REITER            V   SALOMONSON                 -       -
     60-        -  -  -       -  -          60    UV       ***NC    C41990
          *-*-*-*-X  50-  -50-  -    A        SRM
INTER HEMISPHERIC DIFFERENCES IN THE ATMOSPHERIC CIRCULATION FROMSATEL
LITE DATA                                                    1  3
DO YOU WANT TO CHANGE A FIELD VALUE?
INPUT Y OR N
?N

FUNCTION (Q, A, D, OR E)?
?Q

FUNCTION (Q, A, D, OR E)?
?E


ACTIVITY TERMINATED
  snumb # 1621c
normal termination
```

Figure 4. Query Dialog and Display

After the system has entered the words NORMAL TERMINATION the user can enter the BYE command, wait for the SESSION ENDED message, and turn off the switches. The message "snumb 1621c" shown in Figure 4 has little significance for query purposes. However, the "S" sumber will be discussed later in this section, since it identifies the user's session at the terminal and permits him to request printouts of reports and lists he has caused to be generated.

4.4.2 Principal Investigator Query

The name of a principal investigator will be entered with the initials preceding the surname, with no periods after the initials, and with no spaces after the initials. Thus, James Quinton Smith's name would be entered as JQSMITH. If the investigator has no middle initial, the character space designated for that initial will be left blank. Thus, William Jones will be entered as W JONES.

It is extremely important for the user to observe the same rules when entering a principal investigator's name for query purposes. Failure to achieve an exact character-by-character match with a name as it appears on the file will cause a miss. For example, within the system, J. Q. SMITH is not the same as J Q SMITH or JQSMITH.

The user also must remember that a name like JQSMITH may appear in more than one task record, since an individual scientist may be involved as principal investigator on several different research tasks. It is also possible for two people with different first names to have the same initials.

The query function of the Work Unit System is designed to display one record at a time. This means that, if directed to find a name like JQSMITH in a principal investigator field, the system will search one record at a time until it finds the first one with JQSMITH in this field. After displaying this record, it will not continue the search until told to do so. If it is given the same instruction again, the system will begin scanning the remaining records until it encounters another

JQSMITH in the principal investigator field. If it reaches the end of the file without finding another JQSMITH, it will return to the beginning of the file and start searching again. After it has found every JQSMITH in the file, it will repeat the original record again.

Understanding this process will aid the user in obtaining his information quickly and effectively. First, he should always be prepared to enter a principal investigator query at least twice. If both displays are identical, the user will know that he has found the only one in the file. If the displays differ, he must continue entering the query until he gets a display that is identical to the original one. The easiest clue to use identifying the original display is the unique task number.

The possibility that two principal investigators will have identical "system" names is a small one; but it does exist. Usually an examination of the displays will permit the user to distinguish between two such individuals rather readily. The records for one particular investigator probably will have several common factors, i.e., same institution, same general subject matter, same NASA monitor, and other similar details.

4.4.3 NASA Monitor Query

The procedures and conditions for querying on the name of a NASA monitor are essentially the same as those for querying on the name of a principal investigator. Since it is entirely probable that each NASA monitor will be responsible for a number of research tasks, the user should be prepared to enter multiple queries when using the system for this purpose. However, since there are other NASA records that list the responsibilities of the various NASA monitors, the Work Unit System may seldom be used to search for NASA monitors. The capability is there, however, to be exercised if the user needs it.

4.4.4 Institution Name

While personal names lend themselves readily to such standard rules as those outlined in subsection 4.4.2, institution names present various problems. For example, the official name for an institution may be different from its popular name (THE XYZ UNIVERSITY instead of XYZ UNIVERSITY, J.Q. SMITH COLLEGE instead of SMITH COLLEGE, etc.); a universiry may have several campuses; a company may have several installations; or a name may be so long that abbreviations are in order. The possible variations are almost limitless.

Under the circumstances, the easiest method of ensuring consistency is to establish a standard list to be used both by the creators and by the users of a system's records. Such a list exists for the Work Unit System, and a copy will be made available at each terminal. The user is encouraged to consult this authority list before attempting a search by institution name.

Except for the use of the standard list, an institution name query is much like a personal name query. The system will display one record at a time, and the user should reiterate his query until all records have been extracted.

4.4.5 Contract Number

The problem of standardization of contract numbers has been solved programmatically in the Work Unit System. The user can enter a contract number with any possible combination of hyphens, parentheses, slashes, commas, periods, spaces, etc. The system will accept his combination. All the user must do is make sure that his letters and numbers are all there and in the proper order.

While this has been accomplished at the expense of a small sacrifice in the record display, users who have wrestled with contract number problems in other retrieval systems will recognize the overall benefit of the approach used in the Work Unit System.

The keystone of this approach is a standard display format in the form XXX NN-NNN-NNN, where X usually represents a letter and N usually represents a numeral (e.g., NGR 36-003-100). If a record for NGR 36-003-100 exists, the user can find it by using any combination of the letters and numerals, such as NGR 36003100, NGR 36/003(100), or even NGR 36, -00310.0. The program compresses the user's entry to NGR36003100, finds the record, and displays it with the contract number shown as NGR 36-003-100.

The small sacrifice necessary to achieve this entails forcing every contract number into the system's pattern of spaces and hyphens. For example, a number that the user might prefer to think of as NASw-1065a will be displayed to him as NAS W10-65A. However, most Work Unit System users will be familiar with contract and grant numbers involved, and transliteration back to the forms normally used for common typewritten versions should present no serious problems.

4.5 Terminal Messages for Improper Queries

The Work Unit System has been programmed to assist the user by providing him with informative messages when he has made an error. While most of these messages are self-explanatory statements, a few examples will illustrate what the user might expect.

For instance, if the user enters a wrong task number, the following sort of dialogue will take place before and after the incident:

System:	FUNCTION (Q, A, D, OR E)?
User:	A
System:	ENTER THE NAME OF SEARCH FIELD
User:	TASK#
System:	ENTER SEARCH FIELD VALUE
User:	9999
System:	THE DESIRED RECORD WAS NOT FOUND ON FILE FUNCTION (Q, A, D, OR E)?

It should be noted that the system always returns to the FUNCTION question to allow the user to reenter his query. From this point, the dialogue proceeds in the same fashion. If, following the above, the user should requery and, for some reason, hit the space bar on the carriage return instead of keying a task number, the dialogue will continue in the following manner:

User:	Q
System:	ENTER THE NAME OF SEARCH FIELD
User:	TASK #
System:	ENTER SEARCH FIELD VALUE
User:	(Hits space bar, back space or carriage return)
System:	BLANK TASK #'S ARE NOT ALLOWED FUNCTION (Q, A, D, OR E)?

One of the features of the system is the use of the word SAME when a series of queries is being made. Having once identified the field and its value (e.g., PRINV and JQSMITH), the user never needs to repeat these. After displaying the first record, the system repeats the FUNCTION question and the FIELD question. If the user enters SAME, the system skips the field-value question entirely and jumps to the DISPLAY question:

System:	FUNCTION (Q, A, D, OR E)?
User:	Q
System:	ENTER NAME OF SEARCH FIELD
User:	SAME
System:	WOULD YOU LIKE DISPLAY OF RECORD INPUT Y OR N
User:	Y
System:	WANT HEADING?
User:	Y

System: (after displaying the heading and record)
DO YOU WANT TO CHANGE A FIELD VALUE?
INPUT Y OR N

User: N

System: FUNCTION (Q, A, D, OR E)?

User: Q

System: ENTER NAME OF SEARCH FIELD

User: SAME

System: WOULD YOU LIKE DISPLAY OF RECORD
INPUT Y OR N

The system has accepted the instruction SAME as meaning same field and same investigator. By repeating these six steps as often as necessary, the user can complete his list of records for JQSMITH. This feature exists principally not to shorten the process but to remove the necessity for keying the field value over and over again with the risk of a typing error each time.

The system will continue to honor the SAME instruction until the user enters a new field designation and field value, or until he ends the session. If he terminates the session and signs off without obtaining all records for a given query, the system will not pick up where he left it. When he signs on again, if he tries to do this, the following dialogue will take place:

System: FUNCTION (Q, A, D, OR E)?

User: Q

System: ENTER NAME OF SEARCH FIELD

User: SAME

System: NO 'SAME' VALUE DEFINED
ENTER NAME OF SEARCH FIELD

The user will encounter other messages similar to those described above. In each instance, the system will return to a familiar standard message so that the query process can continue in a normal manner.

4.6 Generating Reports and Lists

Like any management information system, the Work Unit System is intended to generate statistical summaries, sorted lists, and other documents intended for use by management as reference tools. The system was designed with the assumption that such documents would be generated periodically and kept on file in the various offices. Thus, the query capability is intended primarily as a supplementary capability to be exercised when necessary between editions. For instance, in subsection 4.4.3 mention was made of avenues other than the query function for use in obtaining information about NASA monitors. One such alternative is a type of product known as the LOS-3 output, which provides lists of the tasks for the various monitors with tasks under each monitor's name grouped by scientific discipline and subarranged chronologically by their anniversary dates. If such products are generated at regular intervals, the latest version may be sufficient for most needs. However, if it should become necessary to check a specific monitor's coverage between issues of the LOS-3 lists, the query function can be used.

There are 25 such products in the Work Unit System. Some of them are needed only once a year, some are needed monthly, and some are needed at irregular intervals. Any or all of them can be produced on demand.

The Work Unit System is designed to enable the terminal user to activate any product or group of products by entering instructions at the terminal. Products so activated are actually processed and printed in batches at the computer service bureau and delivered to the user's office.

In generating a product, the user stipulates which file he wants covered by it and which portions of the file he wants included. At present, the system contains two files, one for OSS records and one for OA

records. Each of these two files is further segmented into the following seven subfiles, or data bases:

1. Supporting research and technology
2. Data analysis
3. Advanced studies
4. Institutional
5. Sounding rockets
6. Manned spaceflight experiment development
7. Other

Each product represents the records in one of these data bases. Consequently, with seven data bases and 25 product types, each file will yield 175 distinct products. Since there are two files, the user can create up to 350 different products from the OSS and OA files.

4.7 Summary Reports

Of the 25 product types generated through the Work Unit System, 16 are summary reports and nine are lists. The principal characteristic of a report is that it provides summary figures on numbers of tasks and numbers of dollars allotted to groups of research tasks in certain categories (the tasks at each installation, the tasks in each division, etc). Figures are displayed in the OPCOP format:

- O = Obligated (for last fiscal year)
- P = Planned (for this fiscal year)
- C = Committed (for this fiscal year)
- O = Obligated (for this fiscal year)
- P = Planned (for next fiscal year)

One of the shorter summary reports is illustrated in Figures 5 and 6. This is the OS-5 Report, which summarizes tasks and funding for the work in each of the divisions and breaks the divisional figures down according

REPORT-ID = OS5 O S S APR. 05 1972

S R & T SUMMARY
FUNDING BY DIVISION STATUS (IN THOUSANDS)

	--FY 71-- OBLIGATED		FY 72 PLANNED		FY 72 COMMITTED		FY 72 OBLIGATED		--FY 73-- PLANNED	
	NO.	$	NO.	$	NO.	$	NO.	$	NO.	$
APOLLO EXPLORATION										
NEW	19	1963	4	40	2	35	1	5	3	140
CONTINUING	82	5300	90	4501	4	289	1	199	76	4473
TERMINATED	0	0	12	50	0	0	0	0	6	0
TOTAL	101	7263	106	4591	6	324	2	204	85	4613
LAUNCH VEHICLES										
NEW	3	164	5	645	0	0	0	0	0	0
CONTINUING	32	2383	34	2955	0	0	0	0	38	4578
TERMINATED	0	0	1	0	0	0	0	0	0	0
TOTAL	35	2547	40	3600	0	0	0	0	38	4578
PHYSICS AND ASTRONOMY										
NEW	29	1012	50	1953	8	326	6	275	2	0
CONTINUING	206	13551	232	12510	96	6465	75	5491	256	18529
TERMINATED	2	29	4	30	0	0	0	0	5	20
TOTAL	237	14592	286	14493	104	6791	81	5766	263	18549
PLANETARY										
NEW	37	2415	71	4098	6	252	5	191	0	0
CONTINUING	228	17643	254	18936	67	5467	60	4998	270	22745
TERMINATED	0	0	10	0	0	0	0	0	2	0
TOTAL	265	20058	335	23034	73	5719	65	5189	272	22745
UNDEFINED										
NEW	0	0	1	15	0	0	0	0	1	0
CONTINUING	0	0	0	0	0	0	0	0	1	0
TERMINATED	0	0	0	0	0	0	0	0	0	0
TOTAL	0	0	1	15	0	0	0	0	2	0
ALL DIVISIONS										
NEW	88	5554	131	6751	16	613	12	471	6	140
CONTINUING	548	38877	610	38902	167	12221	136	10688	641	50325
TERMINATED	2	29	27	80	0	0	0	0	13	20
TOTAL	638	44460	768	45733	183	12834	148	11159	660	50485

Figure 5. Sample OS-5 Report from OSS File

REPORT-ID = OS5 O A APR. 05 1972

S R & T SUMMARY
FUNDING BY DIVISION STATUS (IN THOUSANDS)

	--FY 71-- OBLIGATED		----------FY 72---------- PLANNED		COMMITTED		OBLIGATED		--FY 73-- PLANNED	
	NO.	$	NO.	$	NO.	$	NO.	$	NO.	$
COMMUNICATIONS										
NEW	10	1070	16	1455	0	0	0	0	0	0
CONTINUING	21	1654	30	3305	0	0	0	0	44	3057
TERMINATED	0	0	1	10	0	0	0	0	2	0
TOTAL	31	2724	47	4770	0	0	0	0	46	3057
EARTH OBSERVATION										
NEW	3	246	75	5774	0	0	0	0	2	130
CONTINUING	168	13600	168	14658	4	204	3	190	239	21009
TERMINATED	3	370	2	0	0	0	0	0	0	0
TOTAL	174	14216	245	20432	4	204	3	190	241	21139
ALL DIVISIONS										
NEW	13	1316	91	7229	0	0	0	0	2	130
CONTINUING	189	15254	198	17963	4	204	3	190	283	24066
TERMINATED	3	370	3	10	0	0	0	0	2	0
TOTAL	205	16940	292	25202	4	204	3	190	287	24196

Figure 6. Sample OS-5 Report from OA File

to status codes (new, continuing, or terminated). Figure 5 represents the OSS File; Figure 6 represents the OA File. Both reports represent SR&T tasks. The word UNDEFINED is generated programmatically whenever division codes have been omitted from records. This is a signal for the file maintenance operator to locate the defective record and change it.

This same general pattern is followed for each of the 16 reports, varying only to accommodate the different breakdowns. Some reports show how division work is distributed among installations, principal investigators, scientific disciplines, etc. Still others show the distribution of work at the various installations.

Some of the reports cover so many pages that the pattern cannot be discerned as readily as it can from these two one-page examples. Therefore the reader may find it easier to use Table 3, which indicates how each report is arranged. The numbers OS-1 through OS-16 identify the output selection programs that generate the reports.

By studying the characteristics of these reports, the reader will discover that the totals among them are interrelated. It is obviously desirable for a series of reports to reflect the condition of the file as of a given cutoff date so that all totals will balance. In a conventional accounting system it is customary to close the books at the end of an accounting period and generate all reports while the books are closed, typically during the night.

Since the Work Unit System is an on-line system capable of generating reports or accepting file changes at any time, however, it is not inconceivable that an operator could be in the process of adding new data to the file at one terminal during the same period that a user was setting up a series of reports at another terminal. While such embarrassing fiascos might be prevented by close administrative coordination, they also can be avoided through judicious use of the system's write lockout feature. If the lockout is set just before a report generation session and released at its conclusion, the consistency of the reports will be guaranteed.

4.8 Lists

The remaining nine Work Unit System output products are lists of various kinds. As compared to reports, the lists are characterized by the following features:

- Each entry is a display similar to the one provided for a query. It provides task number, installation or contractor name, contract number, investigator's name, anniversary date, and OPCOP funding.

Table 3. Characteristics of Work Unit System Summary Reports

No.	Name	Breakdowns	Totals	Remarks
OS-1	Division	Data base Division	Division Data Base	Figures are for entire division.
OS-2	Installation	Data base Installation Division Task	Division (locally) Installation	Figures are not for the division as a whole, just for the divisions represented within an installation, e.g., all the "launch vehicles" tasks at Ames.
OS-3	Division/Installation	Data base Division Installation	Installation Division	Figures are for entire division. Report shows how work of each division is distributed among the installations. Division and data base totals are the same as those of OS-1.
OS-4	Institution Category	Data base Institution category Status code	Status code within category Category Status code, all categories All categories, all codes	For each of the six institution types (university, nonprofit, etc.) the figures show how many tasks were new, how many were continuing and how many were terminated in each of the three fiscal years (i.e., last, this and next). Totals for data base same as those of OS-1.
OS-5	Division/Status	Data base Division Status	Status code within division Division Status code, all divisions All codes, all divisions	For each of the six divisions, figures show how many tasks were new, how many were continuing and how many were terminated in each of the three fiscal years. Division and data base totals same as those of OS-1.
OS-6	Step-funded Grants	Data base	Data base	Summary report on all step-funded grants in the data base.
OS-7	Principal Investigator Involvement	Data base Division Principal Investigator	Investigator Division	Reports on the investigators in each of the six divisions. Names of investigators are listed in alphabetical order. In addition to the regular totals, this report has a special line showing the total number of investigators in the division.
OS-8	RTOPS and Tasks	Data base Division Installation RTOP number	RTOP number Division Data base	Within the data base, each division starts on a new page and runs over to additional pages if necessary. First breakdown is by installation. Work of each installation is shown by RTOP numbers arranged numerically. No totals for installations. Division totals shown at end of each division display. Data base totals shown in grand-total line on last page for each data base.

Table 3. Continued

No.	Name	Breakdowns	Totals	Remarks
OS-9	Division by Scientific Discipline	Data base Division Scientific discipline	Division Data base	Separate report for each division. Division identified in the title line of the header. Separate line for each discipline gives OPCOP totals for that discipline within the division. Report totals for division and grand total for data base. Disciplines are arranged in order of the three-letter codes shown in Section 3.26, but the actual names are displayed in the report.
OS-10	Division by Installation	Data base Division Installation Scientific discipline	Installation Division	Same as OS-9 except that the elements within each division are first broken down by installation and then by discipline.
OS-11	Installation by Division	Data base Installation Division Scientific discipline	Division Installation	Similar to OS-10. Separate page for each installation. Elements first broken down by division within the installation and then by discipline within the local division.
OS-12	Division by Institution Category	Data base Division Category Scientific discipline Status	Discipline Status Category	Complex breakdown. Separate report for each division. Within the division the first breakdown groups all elements for each institution category. Within the category, elements are arranged by discipline. Within the discipline, figures show how many tasks were new, how many were continuing and how many were terminated each year.
OS-13	Division by Discipline/Status	Data base Division Scientific discipline	Discipline Division	Same as OS-12 except that the disciplines are listed in one sequence and not broken down by institution category.
OS-14	Division Step Funded Grants by Discipline	Data base Division Discipline Status	Division Data base	Limited to tasks being performed under step-funded grants. Separate report for each division. Broken down only by discipline.
OS-15	Division by Principal Investigator Involvement	Data base Division Scientific discipline Investigator	Discipline Division	Separate report for each division. Broken down first by discipline and then by names of investigators working in each discipline. In addition to other totals, separate lines show total number of investigators for each discipline and for each division.
OS-16	Division by RTOP and Task	Data base Division Scientific discipline RTOP number	Division Data base	Report broken down by division. Within each division, elements are first grouped by scientific discipline then arranged numerically by RTOP number.

- Each product gives a list of such displays for tasks fitting a particular criterion (e.g., all tasks in Pennsylvania, all tasks in which J. Q. Smith is involved as principal investigator, all tasks under NASA monitor J. P. Jones, etc.).

- At the end of each list, OPCOP figures are totaled. The totals show how the funds for the tasks on the list are distributed among the five basic activities (theory, instrumentation development, data reduction, ground research, and program support).

The various lists are described in Table 4. The numbers LOS-1 through LOS-9 refer to the list output selection programs used to generate these products.

4.9 Generating a Report or List

Using the terminal to generate a report or a list amounts to setting up a run in the computer room by remote control. In setting up the run the user must enter three items: the name of the file to be used, the OS or LOS number of the product to be generated, and the data base(s) to be included.

Naming the file for this run is much the same as naming the file for a query run. The user signs on according to the procedure discussed on Pages 22 and 23, just as he would if he were about to process a query. However, when he reaches the point where the system asks the OLD OR NEW question, instead of answering OLD OAQ or OLD OSSQ he answers OLD OA1 or OLD OSS1. This response starts the report/list run and selects the file to be addressed.

At this point in the process the system has summoned a set of previously stored run instructions known as a run stream. One of these instructions contains an OS or LOS number; another contains coded information identifying one or more data bases. If the user were to enter the single word RUN at the terminal, the system would generate a product for him. However, the user could determine which product it was and what data base coverage it had only by telephoning the computer room in Bethesda and asking the operator to print out a copy of everything just generated by the system.

Table 4. Characteristics of Work Unit System Lists

No.	Name	Breakdowns	Totals	Remarks
LOS-1	RTOP	Data base RTOP number Installation number	RTOP	Separate list is given for each combination of an installation number. The basis for the installation selection is the number in the last two digits of the task number. If the work is being performed by a contractor, his name is shown in the installation/contractor portion of the display.
LOS-2	Discipline/RTOP	Data base Discipline RTOP number Installation number Task number	RTOP Discipline	Separate list is given for each scientific discipline. Tasks are grouped together under a combination of RTOP number and installation number, then arranged by task number.
LOS-3	NASA Monitor	Data base Monitor RTOP/Installation Task number	RTOP	Instead of a single list for each monitor this program produces separate lists for him by combination of RTOP and installation number. The English language equivalent of the RTOP number, as shown in the Agency-Wide Coding Structure, appears in the heading of each list.
LOS-4	Principal Investigator	Data base Investigator	Investigator	Separate list for each investigator.
LOS-5	Institution/Principal Investigator	Data base Institution Investigator Task number	Institution	Separate list for each institution. Tasks grouped under names of principal investigators and arranged by task number.
LOS-6	State	Data base State	State	Separate list for each State.
LOS-7	Discipline/Anniversary Date	Data base Discipline Anniversary date Task number	Discipline	Separate list for each discipline. Tasks are grouped by anniversary date, earliest first, then listed within date groups in task number sequence.
LOS-8	Status/Year	Data base Fiscal year Status Task number	Status	Separate report for each fiscal year and code. Tasks are grouped according to their status codes as of that fiscal year. All new tasks of FY71, for example,are listed in task number order and totalled. All continuing tasks for FY71 are grouped separately as are all tasks terminated in FY71.
LOS-9	Data base	Data base Task number	None	Deviates from other lists in that complete record is displayed for each task. All tasks in the data base are listed, in task number sequence.

Therefore, the user should display the run stream, find the two instructions, and see what kind of a product the system is ready to generate. He does this by entering the word LIST. On the day this manual was prepared the run stream looked like the illustration in Figure 7.

```
100##S,U(38) ^,8,16
200$^IDENT^FHREP,CB
300$^REMOTE^$$,SA
400$^SELECT^WDSAI1094001/COS6
405$^SELECT^WDSAI1094003/SYSEXU
410$^ENTRY^C.SYST
500$^EXECUTE
502$^LIMITS^,30K,,50000
505$^REMOTE^P*,SA
700$^FILE^E1,X5S,50L
800$^FILE^S1,X1S,50R
900$^PRMFL^EA,R/W,L,WDSAI1094001/OSSDATBB
950$^FILE^RT,X2S,5L
1000$^REMOTE^UT,SA
1100$^DATA^DA
1200#P
1300$^ENDJOB
```

Figure 7. Typical Run Stream

The instruction containing the product identification is the first one containing the word SELECT:

400$ SELECT WDSAI1Ø94ØØ1/COS6

The slash distinguishes a zero (numeric) from the letter (alphabetic) O. The last three characters identify the product as an OS-6. If the user wishes a different product, he simply copies this instruction, character by character, substituting his own product designation (LOS6 for LOS-6, OS5 for OS-5, etc.) immediately after the letter C. The terminal keyboard will have a key for the vertical arrowhead and one for a zero. It will not be necessary to overstrike a slash on the keyboard, but it will be necessary to strike the numeric zero key rather than the alphabetic O key when a zero is intended.

The new line will replace the old one in the run stream and will remain in place until someone replaces it with a line containing another

product number. It follows, of course, that if the user happens to want the product currently identified when he displays the run stream, he does nothing about this particular line.

The instruction for data base coverage is the one immediately following the only line in the stream containing the word DATA. In Figure 7 this line is:

12ØØ#P

This system will include all data bases in the file unless instructed to the contrary. The absence of anything following the letter P indicates that at this particular time the system was set up to cover all seven. If the user wishes to include only one particular data base, he retypes this line and adds the desired data base code numbers immediately after the P. Thus 12ØØP136 would produce a product for SR&T, advanced studies, and manned spaceflight experiment development.

The data base codes are listed in Sections 2.4 and 3.28 but are repeated here for convenience:

- 1 = Supporting research and technology (SR&T)
- 2 = Data analysis
- 3 = Advanced studies
- 4 = Institutional
- 5 = Sounding rockets
- 6 = Manned spaceflight experiment development
- 7 = Other

After he has modified these two instructions, or determined that they are already formulated properly for the desired product, the user need not examine the run stream again. He can do so, if he wishes, reentering the instruction LIST. This will display the new run stream with the revised product and data base instructions in their proper positions.

It is a good idea for the user to make this kind of check, particularly if he is a new user. He may have made a typographical error in revising a line. If he tries to run the job with such an error in the run stream, the system will be aborted and the user may need the assistance of a programmer to get him out of his difficulty. In case he finds a typographical error when he displays the run stream, he merely has to type the line over again.

When he has satisfied himself that the two instructions are correctly typed, he enters the instruction RUN. At this point there will be a delay while the job waits its turn in the queue. Because a time-sharing system is used simultaneously at many different terminals for many different purposes, the system has a routine that works very much like the retail-store system in which each customer picks a numbered tag off a rack when he enters the store and waits for his number to be called. In the time-sharing system the number is assigned by the computer, the instructions entered by the user are stored in a temporary holding file, and the job is processed automatically when its number comes up. This number, usually referred to by Work Unit System personnel as the "SNUMB" number, is assigned right after the user enters RUN at his terminal. The system reports it by displaying a message like SNUMB # 4231E.

As soon as he sees the SNUMB number, the user can proceed to set up another run by keying a new OS or LOS number in the proper SELECT line and changing the data base codes in the P line if necessary. When he then keys the RUN instruction, the system will give him a new SNUMB number for that product.

After he has entered all the jobs he wishes run, the user can check the status of the jobs he has just processed by entering a job status request consisting of letters JSTS and the SNUMB number of each one. There are several answers the system might give him. If he enters a job status request before the system has had a chance to react, it might even provide the disconcerting message NOT YOUR JOB. Therefore it is wise to wait a few minutes after entering the last job before asking the system

for status reports. The length of time required depends primarily on the number of people using the system and, hence, the number of jobs waiting to be processed. The user can return every few minutes to request the status of his last job. Finally the system will report completion with the words NORMAL TERMINATION. The closing dialogue will look like this:

```
User:       JSTS 4231E

System:     4231E OUTPUT COMPLETE
            IF LAST JOB SUBMITTED, STATUS WAS:
            NORMAL TERMINATION

User:       BYE

System:     **TSS RESOURCES USED ØØ2
            **TIME SHARING OFF AT 12.861 on 2/26/72
```

The command BYE is the user's command for sign-off. Upon receipt of this command, the system will report the number of time-sharing resources used during this particular session at the console as well as the time and date of the sign-off. The resource is a time period on which billing will be based at the end of the month. Unless the user has administrative instructions to the contrary, he can ignore this information, which will be retained in the system for subsequent compilation.

There is one other item that should be considered before turning to a discussion of means of obtaining copies of reports generated during the run. This is the matter of what to do if the traffic is so heavy that several hours elapse without a normal termination. If the user checks the status several times over a period of, say, 15 minutes, and still finds his job caught in the traffic somewhere, he can give the BYE command, receive the sign-off report, and turn off the terminal. Later in the day, at his convenience, he can sign on again and check the status of his job. To do this, he follows the sign-on routine down to the usual SYSTEM? question, which he answers simply with JSTS 4231E (or with whatever SNUMB number applies to the job). If the job is ready, the dialogue will proceed as indicated above.

When he finally receives the NORMAL TERMINATION report, gives his BYE command, and receives the sign-off report, the user can consider his terminal work completed as far as that particular batch of products is concerned. At that point, the system will have his products stored in machine-readable form under the control of a routine known as SYSOUT. To obtain paper printouts of the products, he must call the computer room in Bethesda and ask them to run the jobs through the printer. The current name and number for such a call are:

Name: WALLY BECK
Number: 656-8859

The person who received the call in the computer room will need to know the station code (always SA), the Resource ID, the date of the run (usually the same day or the previous working day), and often the SNUMB numbers. He also will need to know how many copies to print (one, two, or four) and, of course, where to send them. Usually the computer room will be able to have them delivered on the same day or at least by the following working day.

4.10 Printing Reports or Lists at the Terminal

It is possible to have reports or lists typed automatically at the terminal instead of having them printed in the computer room for later delivery. This is an option that should be exercised with discretion, especially where certain voluminous products are concerned. Nevertheless, it is a useful option when immediacy is a factor.

To initiate terminal typing of one of these products, the user first generates the desired product according to the procedure outlined in subsection 4.9. However, at the point where he reenters the line for the data base codes (the one illustrated as 1200#P) he leaves a blank where the P would normally appear.

After the run has progressed to the point where the system has delivered the NORMAL TERMINATION report, he depresses the break (or interrupt)

key. This will actuate the SYSTEM question, to which he responds JOUT 2521B. (The 2521B in this response represents the S or SNUMB number of the job.)

This will produce a FUNCTION question, not the one normally used in the query routine but simply the unqualified word FUNCTION. The user responds with the command LIST, whereupon the system displays the following:

ACTIVITY 1

REPORT CODES

$$

74

63

FUNCTION

The user responds EPRINT 63 and waits while the system types out the report at the terminal. After the report has been completed, the system will present the FUNCTION question again. This time the user responds with REMOVE and receives the SYSTEM question again. He can either enter JOUT with another SNUMB number for a different report (if he generated more than one) or enter BYE to sign off.

The figure 63 discussed above is displayed when everything is normal. The appearance of a 67 instead of a 63 it indicates a problem with the data base codes in the run stream. If this happens, the user must enter EPRINT 67 according to the following dialogue:

```
System:     ACTIVITY 1
            REPORT CODES
            $$
            74
            67
            FUNCTION

User:       EPRINT 67
```

System: DATA BASE CODES 1357 are INVALID
RUN ABORTED
FUNCTION

The 1357 in the above message is a hypothetical string of data base codes. In this instance, the error is the use of a figure other than 1, 2, 3, 4, 5, or 6. Whatever string of characters the user has used in setting up the run will be repeated in this display to enable the user to determine the nature of his error. If he cannot detect an error in the displayed data base codes, it is possible that a different type of problem exists in the system. In this case it is most desirable for the user to leave the entire job in the computer and call the programmer. To save the evidence, the user depresses the carriage return key. This will produce the SYSTEM question again, and the user should terminate the session immediately by entering BYE. After he has disconnected he should call the programmer, report the situation, and provide the SNUMB number of the offending job. With the SNUMB number the programmer can call up a record of the complete series of transactions to determine what went wrong.

Much the same thing applies if there is a blank where the 63 or 67 should be. In this case, though, the user should substitute a carriage return for the EPRINT line. This will produce the SYSTEM question, to which the user responds BYE and proceeds as above.

If the data base codes displayed after a 67 report contain obvious errors, the user can take corrective action on his own. Right after the RUN ABORTED - FUNCTION message he enters the command REMOVE. This will remove the entire job back to the point at which he first initiated the run to generate the report or list. the REMOVE command will produce the SYSTEM message, to which the user will respond CARD and run the job over again, following the procedure outlined in subsection 4.9.

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